Peripheral Collisions with STAR

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In peripheral collisions, the two nuclei physically miss each other, but interact electromagnetically. These processes include two-photon and photonuclear interactions such as photon-Pomeron or photon meson fusion to produce vector mesons. Our initial focus is on reactions with large cross sections and good reconstruction efficiency: photonuclear ρ, ω and ϕ production, and two-photon production of e^+e^- pairs and the $f_2(1270)$[1].

The vector meson rates and rapidity distribution depend on the vector meson-nucleon cross sections. Because of the coherent coupling, this cross section is huge, about 10% of the hadronic cross section for gold beams[2]. Because of the large impact parameter, the two nuclei act as two separate pointlike meson sources. Since it is impossible to tell which nucleus is the source, the amplitudes add. For meson $p_\perp \ll \hbar/b$, destructive interference is expected, producing an easily visible dip in the $p_\perp$ spectrum[3].

Electromagnetic production of e^+e^- pairs is of interest because the coupling constant $Z\alpha$ is sufficiently large that perturbative calculations are questionable. Rate measurements can distinguish between various non-perturbative calculations. The two-photon width of the $f_2(1270)$ is well known. So, any excess rate is a sign of other production channels, such as photonuclear interactions. This measurement is important for planning future work.

In 1999, we refined our analysis techniques and software. Our Monte Carlo, STARlight, has been upgraded, and photonuclear interaction channels are being added. We have processed large event files through bfc, the STAR reconstruction chain. In the process, we found and fixed a number of bugs that were specific to low multiplicity events. A new vertex finding routine, lmv, was written to handle events with fewer than ~ 10 primary tracks. This vertex finder also properly accounts for errors when projecting tracks back through the TPC inner field cage and beampipe. A peripheral collision maker, StPecMaker was written and integrated with STAR software. The maker reconstructs multi-particle final states, calculating invariant masses, decay angles and the like. We are also developing quality assurance histograms specific to these small events.

Since triggering on low multiplicity events is so critical to the peripheral collisions program, we are developing a slow simulator for the MWPC wire chamber trigger. This new simulator will properly account for the drift times for ionization to reach the anode wires. We have also continued development and tuning of trigger algorithms, awaiting an infrastructure to begin implementation.

References

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[2] S. Klein and J. Nystrand, Phys. Rev. **C60**, 014903 (1999).

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Footnotes

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